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ABSTRACT

This report is the second in a series based on data collected for an evaluation of the Class Size Reduction Program. This study examined the impact of the teacher on student achievement. The study used multilevel statistical techniques to examine the teaching strategies and techniques observed in the classroom that were significant predictors of student achievement as measured by the spring 2000 Stanford Achievement Test/9 reading, mathematics, and language subtests. The analysis included controlling for student-level and teacher-level characteristics that might have otherwise biased the results. Some of the control variables at the student level included pretest national curve equivalent score (spring 1999), language classification, grade-level, and socioeconomic status (measured by free or reduced-price lunch). The teacher-level predictors included credentials and years of teaching experience. Results indicate that there are specific observed teaching techniques that impact student achievement in reading and language. The use of classroom management skills is a significant predictor of reading achievement, and language achievement appears to be positively related to skills associated with individualization and engagement of students. The teaching behaviors measured did not predict mathematics achievement. Teaching status (permanent versus nonpermanent) had a positive impact on students' reading, mathematics, and language posttest scores (spring 2000). English language learners in grade 2 with more experienced teachers showed larger mathematics and language gains. A similar pattern was observed for third grade. Students in both second and third grades had been in reduced size classes for 3 years. Overall results suggest that teacher experience and status (credential) and certain classroom techniques improve student achievement. An appendix outlines the teaching strategies studied, and a second appendix describes the student and teacher samples. (Contains 9 tables, 12 figures, and 19 references.) (SLD)

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ED 473 460

The Relationship Between Teacher Instructional Techniques and Characteristics and Student Achievement in Reduced Size Classes

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EXECUTIVE SUMMARY

Introduction

This report is the second in a series of three reports based on data collected during the 1999-00 school year for an evaluation of the Class Size Reduction Program. The first report in this series examined the impact of class size reduction (CSR) on achievement among 3rd, 4th, and 5th grade students with different numbers of years of participation in the program. This report extends beyond the first by examining the role of the teacher in impacting student achievement.

The purpose of this study was to use multilevel statistical techniques to examine which teaching strategies and techniques observed in the classroom were significant predictors of student achievement as measured by the spring 2000 SAT/9 reading, mathematics, and language subtests. The analysis included controlling for student-level and teacher-level characteristics that might have otherwise biased the results. Some of the control variables at the student-level included the following: pretest (spring 1999) NCE score, language classification, grade-level, and SES (free/reduced lunch). The teacher-level predictors included credentialing and years of teaching experience.

Conventional wisdom suggests that effective teachers should increase the probability that a student will learn. Teachers possess an entire repertoire of teaching strategies, techniques, and characteristics that may or may not lead to student achievement. The focus of this analysis was to determine which strategies, techniques, and/or characteristics of the teachers resulted in increased student achievement on the SAT/9 reading, mathematics, and language subtests.

Findings

The multilevel analysis took into consideration the fact that students are "nested" or grouped within teachers. The results indicated that there were specific observed teaching techniques that impacted student achievement in reading and language. The use of classroom management skills was a significant predictor of reading achievement. Language achievement appeared to be positively related to those skills associated with individualization and engagement of students. However, the teaching behaviors we measured did not predict mathematics achievement.

Additional findings from the multilevel analysis revealed that teaching status (permanent versus non-permanent) had a positive impact on students' reading, mathematics, and language posttest scores (spring 2000 NCE scores). This impact appeared to be the strongest for reading and language, followed by mathematics.

Exploratory analyses were then used to examine the relationships between teaching experience and teaching status by language classification. The analysis with regard to teaching experience indicated that English Language Learner (ELL) students in 2nd grade classrooms where the teacher had 3 to 10 years experience scored significantly larger adjusted mathematics and language gains than those students who had the least experienced teachers. The results for 2nd grade English Only (EO) students suggest that those students who had the most experienced teachers scored significantly larger mathematics gains than those students who had the least experienced teachers. The effect size (ES) for this difference is educationally important ($\underline{d}$ = .20).

The 2nd grade findings for teaching status indicate that those ELL students who had permanent teachers scored larger adjusted gains than those students with non-permanent teachers across all three SAT/9 tests. However, the only statistically significant difference between

permanent and non-permanent teachers was in reading. The findings for 2nd grade EO students indicated that students having permanent teachers, on the average, scored larger adjusted gains on all achievement tests than EO students with non-permanent teachers. The effect sizes for reading, language, and math were d = .40, d = .67, and d = .45, respectively. These effect sizes reflect a medium to large impact on adjusted gains due to teaching status.

The findings for 3rd grade ELL students' adjusted achievement gains were similar across categories of teaching experience. The analysis for 3rd grade EO students did not result in any significant differences between student achievement and categories of teaching experience. In retrospect, the trend for ELL students was very similar to the trend for EO students with respect to teaching experience.

Third grade ELL students who had permanent teachers scored smaller adjusted losses on all achievement tests as compared to those students who had non-permanent teachers. The 3rd grade EO adjusted reading, mathematics, and language gains were larger for those students who had permanent teachers as compared to the adjusted gains for the students with non-permanent teachers. However, there were no statistically significant differences between students with permanent teachers as compared to those students with non-permanent teachers.

Conclusions

This study investigated the impact of teaching techniques and teacher characteristics in reduced size 2nd and 3rd grade classrooms using data from both classroom observations and matched student achievement scores. The analysis considered student characteristics and teacher characteristics. Both the 2nd and 3rd grade students had been in reduced size classes for three years. Thus, the average number of students per class meeting this criterion was less than 20.

While previous research suggests that smaller class size may help to improve student achievement, it is unclear how this outcome is related to the content of instruction in specific subject areas. Stasz and Stecher (2000) found that students in reduced size classes spent more time during language instruction writing narrative pieces. They also found that students engaged in mathematics instruction played mathematics games, and examined relationships using numbers.

Stasz and Stecher (2000) examined other factors that may have affected their results. They compared teacher characteristics of those in reduced and non-reduced size mathematics classes. They found that there were a few significant differences in teacher attributes, such as having a master's degree and staff development that may result in increased student achievement. However, Stasz and Stecher (2000) were unable to examine the relationship between instructional practices and student outcomes because they could not link the data to individual students.

This study used multilevel modeling (HLM) to uncover the relationships between teaching strategies and characteristics, and student achievement. The results of the multilevel analysis revealed that after controlling for student-level variables such as language classification, grade level (2nd vs. 3rd), and spring 1999 SAT/9 NCE scores, the significant teacher-level predictors of SAT/9 spring 2000 NCE reading scores were teaching status (permanent vs. all others) and classroom management. The findings further indicated that teaching status was a significant predictor of mathematics and language outcomes. Individualized instruction was also a significant predictor of language outcomes. This means that on average, that teachers who were credentialed and experienced, had students who made the largest adjusted gains in reading,

mathematics, and language. Previous research shows the greater use of individualization in smaller size classes (Molnar, Smith, Zahonk, Palmer, Halbach, & Ehrle, 1999).

The current study adds to the literature about the relationship between teaching techniques and behaviors and student achievement. The results presented in this paper have suggested that for 2nd and 3rd grade students in LAUSD, teacher experience and status (credential), as well as certain classroom techniques, improve student achievement.

The Relationship between Teacher Instructional Techniques and Characteristics and Student Achievement in Reduced Size Classes

This report is the second in a series of three reports based on data collected during the 1999-00 school year for an evaluation of the Class Size Reduction Program. The first report in this series examined the impact of class size reduction (CSR) on achievement among 3rd, 4th, and 5th grade students with different numbers of years of participation in the program. This report extends beyond the first by examining the role of the teacher in impacting student achievement.

Conventional wisdom suggests that effective teachers should increase the probability that a student will learn. Teachers possess a repertoire of teaching strategies, techniques, and characteristics that may or may not lead to student achievement. The focus of this analysis was to determine which strategies, techniques and/or characteristics of the teachers resulted in increased student achievement on the SAT/9 reading, mathematics, and language subtests.

Literature Review

Research suggests that school factors, such as class size (Glass, Cahen, Smith, & Filby, 1982; Mosteller, 1995) and teacher quality (Ferguson, 1991) influence student achievement. There has not been much empirical evidence linking teacher instructional techniques and student achievement. However, Darling-Hammond (2000) found that schools can make a difference in mathematics and a great portion of the difference is due to teacher preparation including credentialing. The Tennessee Value-Added Assessment System (Sanders & Rivers, 1996) illustrated large teacher-to-teacher differences in student learning. Sanders and Rivers also showed that teachers' efforts were additive and cumulative.

Within the research on the role of the teacher in fostering student achievement, the focus has been on teacher qualifications (e.g. credentialing and years of experience). In response to this research, more than 25 states have enacted legislation to improve teacher qualifications (Darling-Hammond, 1997). These states have implemented improvements in teacher education, certification, professional development, and recruitment practices.

Sanders and Rivers (1996) found that effective teachers are far more important to student learning than most other large reforms. Unfortunately, their research did not include an examination of explicit teaching techniques.

Stasz and Stecher (2000) investigated the effects of smaller class sizes on teacher instructional techniques. Their results indicated that there were only a few differences found between reduced and non-reduced classes in teacher instructional practices. Stasz and Stecher (2000) were unable to examine the relationship between instructional practices and student outcomes directly. This was due to their inability to link teachers' survey responses to student test scores.

Research on teaching effectiveness has generally indicated that teachers with more teaching methods courses, more professional development, and more enthusiasm, have higher achieving students than teachers with lower levels on these indicators. Darling-Hammond (2000) found that measures of teacher preparation and credentialing were strongly related to student achievement in mathematics and reading, both before and after controlling for student poverty and language status.

Measurement and Statistical Issues in Educational Data

Residualized (Adjusted) NCE Gain Scores

This study employed regression analysis to adjust the pretest scores for pre-existing group differences in order to estimate an adjusted or residualized gain score for each student. The

posttest scores were regressed on the pretest scores in order to obtain the residual scores. The residual scores represent improvements and/or decrements in student achievement. The adjusted difference scores will be referred to as "adjusted gains" in this report.

Students "Nested" within Teachers

Educational research usually involves nested or hierarchical data structures. This means that students are located, or "nested," within teachers' classrooms, and teachers are located, or "nested," within schools. Traditional statistical techniques have not adequately considered this. Consequently, differences that may be due to unique effects teachers may have on student achievement are often not considered. Previous research has ignored the fact that students are located in different classrooms. The problems created by this approach were recognized (e.g. Burstein, 1980), but remained statistically intractable. There have been recent developments in statistical software that now enable researchers to examine these relationships (Bryk & Raudenbush, 1992). Multilevel modeling allows us to take into account the fact that students are located, or nested, within particular classrooms and to analyze effects that may be related to teachers.

Purpose of Study

The purpose of this study was to use multilevel statistical techniques to examine which teaching strategies and techniques observed in the classroom were significant predictors of student achievement as measured by the spring 2000 SAT/9 reading, mathematics, and language subtests. The analysis included controlling for student-level and teacher-level characteristics that might have otherwise biased the results. Some of the control variables at the student-level included the following: pretest (spring 1999) NCE score, language classification, grade-level, and SES (free/reduced lunch). The teacher-level predictors included credentialing and years of teaching experience.

Research Questions

1) Were there any teacher-to-teacher differences in the outcome variables (SAT/9 reading, mathematics, and language NCE adjusted gain scores)? If so, what factors were related to these differences?

2) Was there a relationship between student characteristics and achievement?

Method

Participants

The participants were 44 randomly selected 2nd grade teachers and 47 randomly selected 3rd grade teachers and their students from 50 elementary schools in LAUSD. There were 1835 students in the sampled teachers' classrooms. Only those students who took both the spring 1999 and spring 2000 test administrations were used in this analysis (matched scores). The student data were obtained from the LAUSD Information Center Branch. The teacher data were either collected during the observations or obtained from files maintained by the LAUSD certificated personnel department.

Design and Procedure

Twelve trained observers visited classrooms during the 1999-00 school year. Observations took place during a 3-hour block of reading/language arts instruction on two occasions. Checklists were used to record teaching strategies and techniques that were exhibited in the classroom during the block of instruction.

Teacher-Level Variables. The teacher instructional techniques and strategies are listed in Appendix A. The 20 instructional techniques and strategies were statistically reduced to three underlying factors that were used in the analysis as indicators of basic teaching techniques

observed in the classroom.[1] The three factors were as follows: 1) individualization and engagement; 2) redundancy, practice, modeling; and 3) classroom management. A fourth variable, learning time was calculated by taking the total minutes spent in learning activities during the observation period divided by the total number of minutes in the observation. Other teacher-level measures were as follows:

- Number of years teaching at current school
- Credential status

Student-Level Variables. Student-level outcome measures were NCE reading, mathematics, and language SAT/9 posttest scores. Additional student-level characteristics that were considered in the analysis are listed below:

- Language program coded as English language learner (ELL) versus all others
- Free/reduced meal program participation (SES)
- Grade (2nd or 3rd)

Results

Sample

A description of the student and teacher sample is contained in Appendix B. The median number of years that teachers taught at their schools was 5 years and the number of years that teachers taught in the district was 8 years. Third grade teachers had fewer years teaching at their schools (Mdn=5) than 2nd grade teachers (Mdn=7). The majority of teachers were fully credentialed.

[1] Because the 20 instructional techniques were highly correlated, they were factor-analyzed (reduced) to three underlying factors or themes. These themes were used as proxy variables for instructional techniques.

Student Achievement

The focus of this analysis was on the relationship between teaching behaviors and student achievement as measured by the SAT/9. There are different ways to measure the change in student achievement between two points in time. In the HLM analysis, pretest and posttest NCE scores were entered into the analysis. However, for all descriptive and inferential statistics reported in this study, adjusted/residualized gain scores were employed. In order to determine the unique contribution of teachers, it was necessary to first examine the relationships between student characteristics and adjusted gains. Did students' adjusted gains in reading, mathematics, and language differ due to the student demographic characteristics?

Table 1

Adjusted NCE Gain Scores by Grade

	Reading			Mathematics			Language		
Grade	n	M	SD	n	M	SD	n	M	SD
2	571	2.15	11.02	602	3.32	14.72	582	1.95	15.40
3	662	.10	10.03	713	-1.10	13.03	672	.39	12.55

Table 1 indicates that 2nd grade students had significantly larger adjusted gains in reading and mathematics than 3rd grade students.[2] However, there were no statistically significant differences between 2nd and 3rd grade students' language scores. It is interesting to note that 2nd grade students' adjusted gains were larger across the three tests than those of 3rd grade students.

[2] Reading-$F(3, 1252) = 8.56$, $p = .00$; Mathematics-$F(3, 1334) = 12.35$, $p = .00$.

Table 2

2nd Grade Adjusted Gains by Meal Program Participation

	Reading			Mathematics			Language		
Free/Reduced Lunch	n	M	SD	n	M	SD	n	M	SD
Yes	443	1.77	11.26	4.77	2.65	14.91	451	.93	15.71
No	102	3.82	9.88	100	6.19	12.86	104	6.65	13.05

Table 2 illustrates that the 2nd grade students who did not receive free/reduced lunch services scored larger adjusted gains than those students who did receive free/reduced lunch services. The adjusted reading gains were not significantly different. However, the adjusted math and language gains were significantly smaller for the lower SES students (free/reduced lunch program).[3]

Table 3

3rd Grade Adjusted Gains by Meal Program Participation

	Reading			Mathematics			Language		
Free/Reduced Lunch	n	M	SD	n	M	SD	n	M	SD
Yes	548	-.55	9.52	589	-1.65	12.74	551	-.33	12.28
No	90	4.26	11.44	90	2.36	14.54	89	5.15	14.12

Table 3 indicates that 3rd grade students adjusted gains were significantly larger for those students not in the free/reduced lunch program as compared to those students who were in the

[3] Mathematics-$t(575) = 2.44$, $p = .02$; Language-$t(553) = 3.90$, $p = .00$.

free/reduced lunch program.[4] This means that the higher SES students had significantly larger adjusted gains than those of lower SES students.

Table 4

2nd Grade Adjusted Gains by Language Classification

	Reading			Mathematics			Language		
Language Classification	n	M	SD	n	M	SD	n	M	SD
ELL	336	1.64	11.54	3.64	3.79	15.05	340	.08	15.49
EO	182	2.51	10.58	185	1.79	15.08	189	3.13	14.86
IFEP	42	4.62	9.58	42	4.96	11.37	61	10.14	14.58
RFEP	9	2.42	6.63	9	5.33	15.21	43	6.91	13.19

The results presented in Table 4 indicate that among 2nd grade students there were no statistically significant differences in adjusted gains due to language classification for ELL and EO students. In reading and language, the EO students outperformed the ELL students. However, in mathematics, the reverse was true. The sample sizes for the two other language classifications are too small to make any inferences.

[4] Reading-$t(659) = 3.78$, $p = .00$; Mathematics-$t(677) = 2.48$, $p = .02$; Language- $t(638) = 3.47$, $p = .00$.

Table 5

3rd Grade Adjusted Gains by Language Classification

Language Classification	Reading			Mathematics			Language		
	n	M	SD	n	M	SD	n	M	SD
ELL	367	-.70	9.67	407	-1.83	13.18	374	-.10	12.39
EO	187	1.43	11.10	195	-2.27	12.82	192	-.38	13.09
IFEP	63	.86	9.65	64	3.46	11.98	61	2.15	12.93
RFEP	44	.15	8.43	43	3.71	11.68	43	4.15	10.54

Table 5 demonstrates that in reading, EO students outperformed ELL students. However, in mathematics and language, ELL students had smaller adjusted losses than EO students. The differences in adjusted gains were not statistically different due to language classification for 3rd grade students.

Table 6

2nd Grade Adjusted Gains by Ethnicity

Ethnicity	Reading			Mathematics			Language		
	n	M	SD	n	M	SD	n	M	SD
Hispanic/Latino	397	2.07	11.35	433	3.49	14.60	404	.79	15.51
Black	67	-.10	11.35	64	-5.14	15.82	69	-2.08	16.12
White	53	4.90	10.19	56	7.94	11.42	56	7.59	13.22
Asian	26	4.64	7.99	23	9.39	14.87	26	7.37	12.09

In this sample, among 2nd grade students, Black students had the largest adjusted losses. White students and Asian students had the largest adjusted reading and language gains. Additionally, Asian students had the largest adjusted mathematics gain scores. There were no

statistically significant results for reading. However, the findings suggested that there were statistically significant differences in adjusted gains for mathematics and language.[5]

Specifically, for mathematics, there was a significant difference in adjusted gains between Black students and all other ethnic groups tabled above. In language, White students and Asian students scored significantly larger adjusted gains than Black students.

Table 7

3rd Grade Adjusted Gains by Ethnicity

	Reading			Mathematics			Language		
Ethnicity	n	M	SD	n	M	SD	n	M	SD
Hispanic/Latino	497	-.22	9.53	544	-1.56	12.83	508	-.31	11.99
Black	57	1.23	9.19	61	-4.77	11.16	59	-2.66	11.86
White	53	4.20	13.26	53	1.12	14.67	52	1.49	14.89
Asian	36	.54	12.70	36	6.37	13.37	35	9.31	12.87

Among 3rd grade students, Asian students had the largest adjusted mathematics and language gains, whereas White students had the largest adjusted reading gains. Black students had the largest adjusted losses in mathematics and language. Hispanic/Latino students had the smallest adjusted gains and losses across all three tests. There were statistically significant differences between ethnic groups for mathematics and language.[6] In mathematics, there was a significant difference between Asian students' and Black students' adjusted gains, and Asian students and Hispanic students' adjusted gains.

In summary, for 2nd and 3rd grade students, adjusted gains were largest for Asian students in mathematics and language. White students had the largest adjusted gains in reading and Black

[5] Mathematics-$F(5,593) = 10.54$, $p = .00$; Language-$F(5,573) = 5.31$, $p = .00$.
[6] Mathematics-$F(6,706) = 6.45$, $p = .00$; Language-$F(6,665) = 7.97$, $p = .00$

students had the largest adjusted losses in mathematics and language. The magnitude of the adjusted gains was different for 2nd grade students as compared with those of 3rd grade students.

In order to account for the hierarchical or nested structure of the data (students located in teachers' classrooms and teachers located in schools), a multilevel analysis was employed. Hierarchical linear modeling (HLM; Bryk, & Raudenbush, 1992) was used to examine the relationship between teaching strategies and student achievement.

Results of Multilevel Analysis

Table 8

Classroom-to-Classroom Differences in Student Outcomes

SAT/9 Subtests	Classroom-to Classroom Differences
Reading	18%
Mathematics	34%
Language	25%

Table 8 shows the percent difference in the outcome variables by classroom. This table indicates that there was a considerable difference in student achievement across teachers (classrooms). For example, more than one-third of the variance in mathematics NCE scores was between classrooms. What factors may have influenced this difference between classrooms/teachers?

One of the purposes of the multilevel analysis was to examine the relationship between teaching status and student achievement. Our preliminary results indicated that there was an interaction between teaching status and years of teaching experience. The findings revealed that credentialed teachers with less than 3 years of teaching experience had students with significantly smaller gains (larger losses) than those students who had credentialed teachers with

3 or more years of teaching experience. Therefore, in this study, experienced credentialed (permanent) teachers were compared to a group of less experienced credentialed and emergency permit teachers (non-permanent).

Table 9

Relationship Among Student-Level Outcomes and Teacher-Level Indicators

Outcome	Student Indicators	Teacher/Classroom Indicators
SAT/9 Reading Score	Language Classification (ELL vs. All Others) Grade Level (2nd vs. 3rd)	Teaching Status (+) Classroom Management (+)
SAT/9 Math Score	Language Classification (ELL vs. All Others) Grade Level (2nd vs. 3rd)	Teaching Status (+)
SAT/9 Language Score	Language Classification (ELL vs. All Others) Grade Level (2nd vs. 3rd)	Teaching Status (+) Individualization and Engagement (+)

After controlling for significant student-level characteristics (pretest score, grade-level and language classification), the important predictors were as follows:

1. SAT/9 reading score – Teaching status[7] and classroom management techniques[8] were positively related to reading outcomes on the SAT/9. This means that reading scores increased more for those classes of students who had permanent teachers than those in classes of non-permanent teachers. In addition, teachers employing specific classroom management skills had students who attained larger achievement gains than those teachers not using this approach. The construct of classroom management included the following characteristics:

    - Teacher provided clear directions

[7] Teaching status–$t(1418) = 2.48$, $p = .01$.
[8] Classroom management – $t(1418) = 3.29$, $p = .00$.

- Teacher appeared enthusiastic and animated
- Teacher maintained control of the classroom
- Teacher was in clear view of all students

2. SAT/9 mathematics' score – Teaching status[9] was positively related to mathematics outcomes on the SAT/9 test. This relationship showed "practical" significance (Kirk, 1996). This means that while the relationship was not statistically significant at the 5% probability level ($p < .05$), it was significant[10] at the 10% probability level ($p <. 10$). Teachers who had permanent credentials were more likely (within a 7% chance of error) to positively impact their students' mathematics achievement.
3. SAT/9 language score – Teaching status[11] and individualization and engagement[12] were positively related to language outcomes on the SAT/9 test. Individualization and engagement of students include the following practices:
   - Teacher began lesson with overview
   - Teacher informed students what would be learned
   - Teacher used examples, illustrations/demos, to explain and clarify
   - Teacher proceeded in small steps, but at a rapid pace
   - Teacher asked questions that were directly relevant to new content/skill
   - Teacher paused after asking question before calling on student
   - Teacher made sure all students participated on a roughly equal basis
   - Teacher acknowledged correct responses as such
   - Teacher tried to elicit correct response
   - Teacher monitored progress during seat work

[9] Teaching status– $t(1418) = 1.98$, $p = .07$.
[10] $p = .07$
[11] Teaching status– $t(1418) = 2.66$, $p = .01$.
[12] Individualization and engagement – $t(1418) = 2.41$, $p = .02$.

Summary of Results

The previous analysis took into consideration the fact that students are "nested" or grouped within teachers. The results indicated that teaching status had a positive impact on reading, mathematics, and language posttest scores (spring 2000 NCE scores). This impact appeared to be strongest for reading and language, followed by mathematics. The observational results indicated that there were specific teaching techniques that impacted student achievement in reading and language. The use of classroom management skills, as listed above, was a significant predictor of reading achievement. However, no particular teaching behaviors predicted mathematics achievement. Language achievement appeared to be positively related to those skills associated with individualization and engagement of students.

Exploratory Analysis of Teaching Credential, Teaching Experience, and Student Achievement

Exploratory analyses were performed on a combined data file that included student-level data and a disaggregated set of teacher-level variables indicating years of teaching experience and teaching status. Years of teaching experience were divided into three groups: 0 to 2 years, 3 to 10 years, and 11 or more years. Teaching status was dichotomized into yes and no. The "yes" category encompassed those teachers in a permanent teaching status. The "no" category included those teachers who were in a probationary or emergency status (non-permanent) in LAUSD. The additional analyses were conducted to examine any possible linear or curvilinear relationships among the variables. These analyses were also performed to examine the differences in mean achievement scores between students having permanent and non-permanent teachers and for mean differences between students having teachers with varying years of experience.

The sample was comprised of 2nd and 3rd grade students and their teachers. Because 2nd and 3rd grade students evidenced different patterns of adjusted gains, the relationships within

grade for the observed classrooms were analyzed separately. Language classification (EO vs. ELL) was also controlled in the exploratory analyses.

2nd Grade Student Achievement and Teaching Experience

Figure 1.
2nd Grade Adjusted NCE Gain Scores for
ELL Students by Years of Teaching Experience

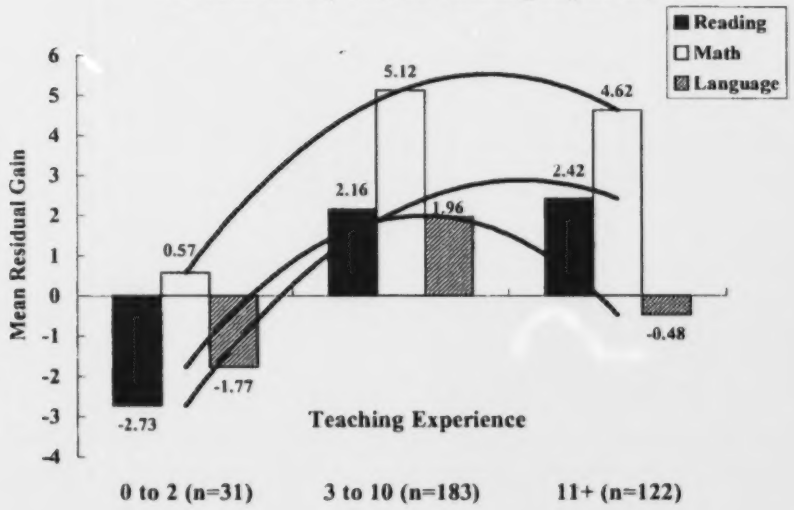

Figure 1 illustrates 2nd grade adjusted gains by teaching experience for ELL students. There was a curvilinear relationship for ELL students between adjusted mathematics and language gains and years of teaching experience. This means that students in classrooms where the teacher had 3 to 10 years experience scored significantly larger adjusted mathematics and language gains than those students who had the least experienced teachers. However, there were no statistically significant differences in adjusted reading gains between years of teaching experience categories.

Figure 2.
2nd Grade Adjusted NCE Gain Scores for
EO Students by Years of Teaching Experience

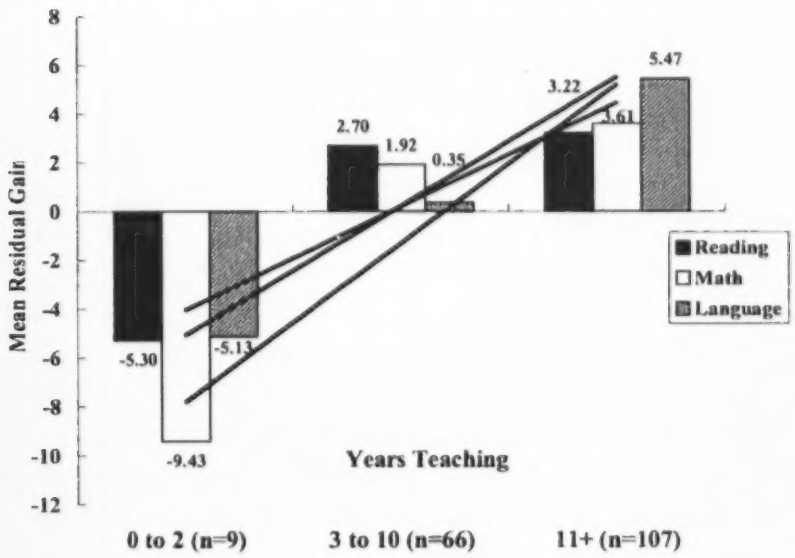

Figure 2 illustrates that the relationship for 2nd grade EO students adjusted gains and teaching experience was linear. The results indicate that there was a significant difference between teaching experience categories for adjusted mathematics gains.[13] This means that EO students who had the most experienced teachers scored significantly larger mathematics gains than those students who had the least experienced teachers. The effect size (ES) for this difference is educationally important ($\underline{d}$ = .20). Figure 2 also indicates a general positive trend for years of teaching in reading and language. However, these trends were not statistically significant.

[13] Mathematics - EO-$\underline{F}(2,167) = 4.03$, $\underline{p} = .02$.

Figure 3.
2nd Grade Permanent Teaching Status by Adjusted NCE Gain Scores for ELL Students

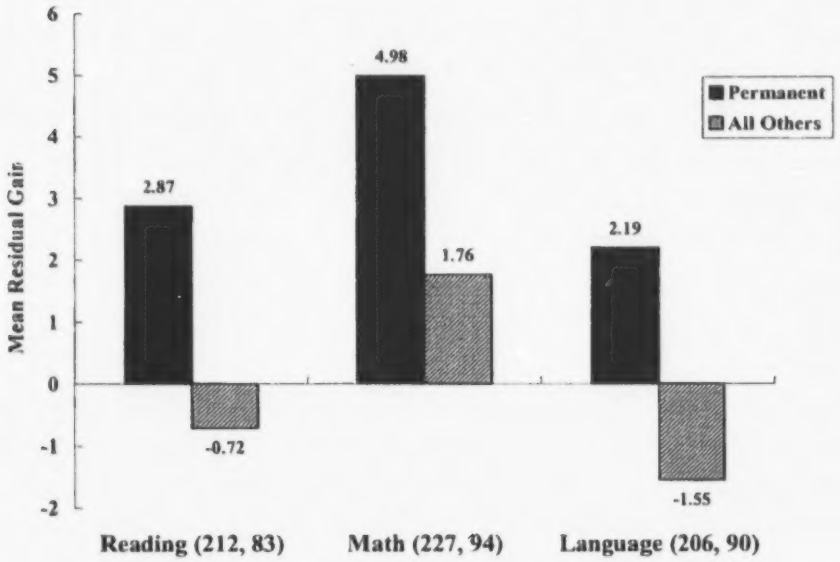

Figure 3 illustrates that ELL students who had permanent teachers scored larger adjusted gains than those students with non-permanent teachers across all three SAT/9 tests. However, the only statistically significant difference between permanent and non-permanent teachers was in reading.[14] The ES for credential status by adjusted reading gains was also educationally important (d = .20). This finding means that students who had permanent teachers scored significantly larger adjusted reading gains than those students who had non-permanent teachers.

[14] $t(286)=2.43$, $p = .02$.

Figure 4.
2nd Grade Permanent Teaching Status by Adjusted NCE Gain Scores for EO Students

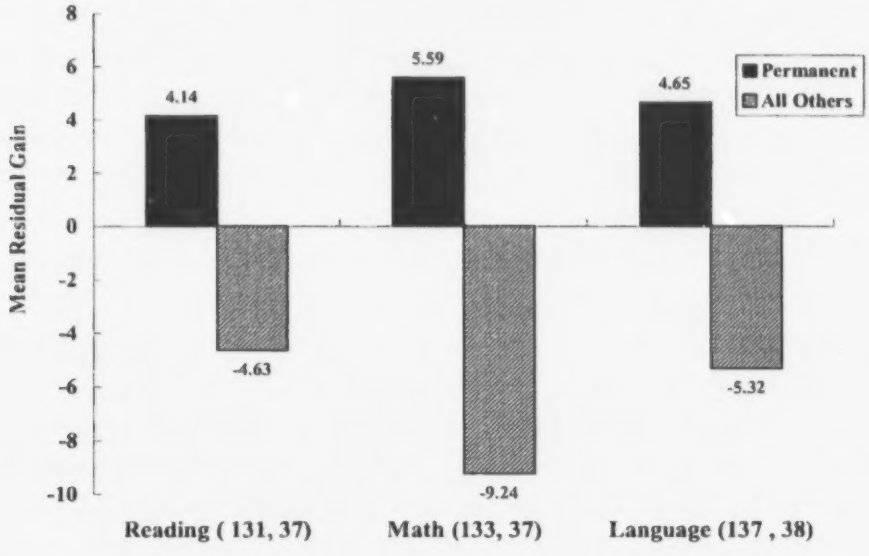

Figure 4 depicts 2nd grade teaching status by adjusted gains for EO students. There were statistically significant differences between achievement and teaching status for reading, mathematics, and language.[15] Further, EO students having permanent teachers, on the average, scored larger adjusted gains on all achievement tests than EO students with non-permanent teachers. The effect sizes[16] for reading, language, and math were d = .40, d = .67, and d = .45, respectively. These effect sizes reflect a medium to large impact on adjusted gains due to teaching status.

[15] Reading- $t(127) = 3.93$, $p = .00$, mathematics- $t(128) = 5.00$, $p = .00$; language- $t(134) = 3.14$, $p = .01$.
[16] Effect Size statistic used in this study is Cohen's d (.2=small, .5=medium, and .8=large).

Third Grade Student Achievement and Teaching Experience

Figure 5.
3rd Grade Adjusted NCE Gain Scores for
ELL Students by Years of Teaching Experience

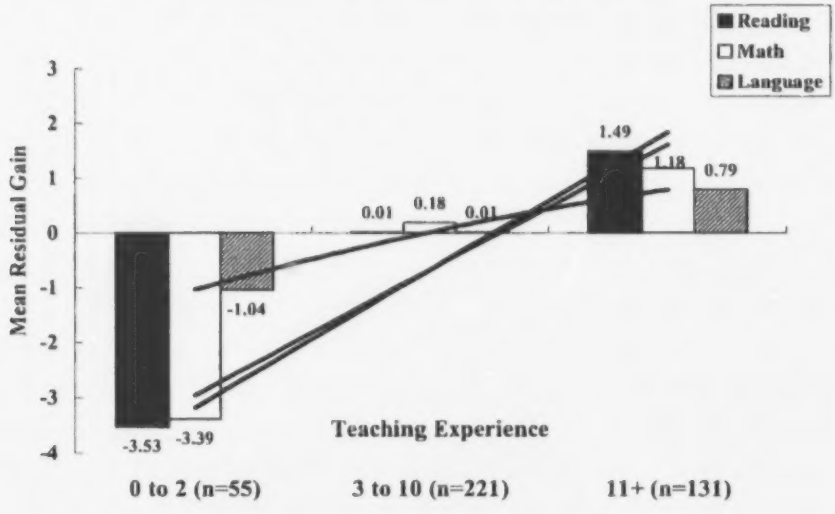

Figure 5 shows the relationship between years teaching experience and adjusted gains for 3rd grade ELL students. The trend for ELL students' language and mathematics achievement by teaching experience was curvilinear. However, the trend for reading gains was linear across years of experience. However, none of the trends were statistically significant. This means that in this sample, teaching experience was not a significant indicator of adjusted gains. The results did not reveal any significant differences between the categories of teaching experience and adjusted gains for 3rd grade ELL students.

Figure 6.
3nd Grade Adjusted NCE Gain Scores for
EO Students by Years of Teaching Experience

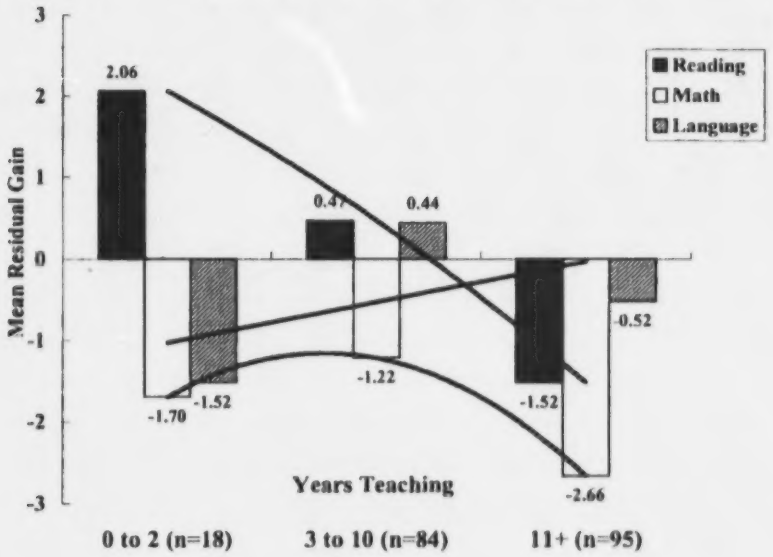

Figure 6 illustrates trends in achievement gains for 3rd grade EO students. None of the trends were statistically significant. The results of the analysis on the aggregated data did not indicate any significant differences between student achievement and categories of teaching experience.

Figure 7.
3rd Grade Permanent Teaching Credential by Adjusted NCE Gain Scores for ELL Students

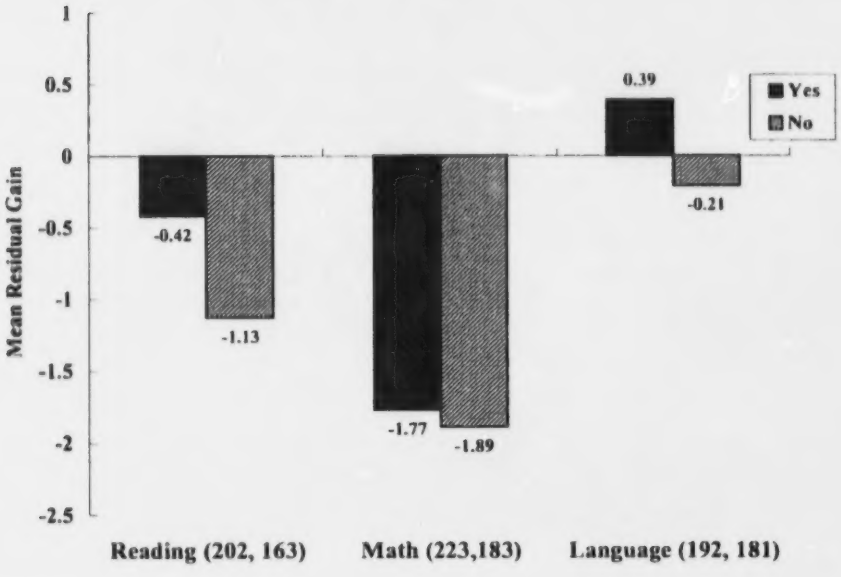

Figure 7 illustrates the adjusted gains for 3rd grade ELL students who had permanent teachers as compared to those students who had non-permanent teachers in this sample. Students who had permanent teachers scored smaller adjusted losses on all achievement tests as compared to those students who had non-permanent teachers.

Figure 8.
3rd Grade Permanent Teaching Credential by Adjusted NCE Gain Scores for EO Students

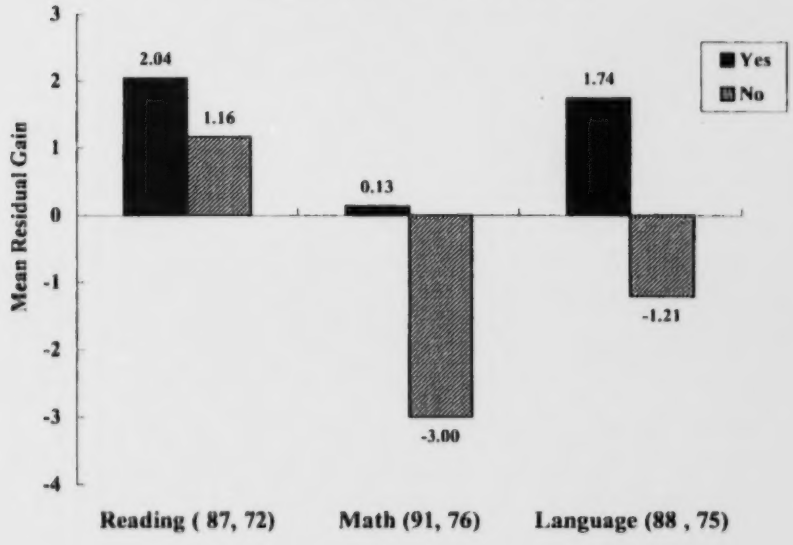

Figure 8 depicts the achievement gains for 3rd grade EO students who had permanent teachers as compared to those students who had non-permanent teachers in this sample. The adjusted reading, mathematics, and language gains were larger for those students who had permanent teachers as compared to the adjusted gains for the students with non-permanent teachers. However, there were no statistically significant differences between students with permanent teachers as compared to those students with non-permanent teachers.

Next, we considered whether there were differences within the previously defined categories--permanent vs. probationary vs. emergency/provisional status. The last four figures present adjusted NCE gains by these three major teaching statuses: permanent, probationary, and provisional.

Figure 9
2nd Grade Adjusted NCE Gains for
EO Students by Teaching Status

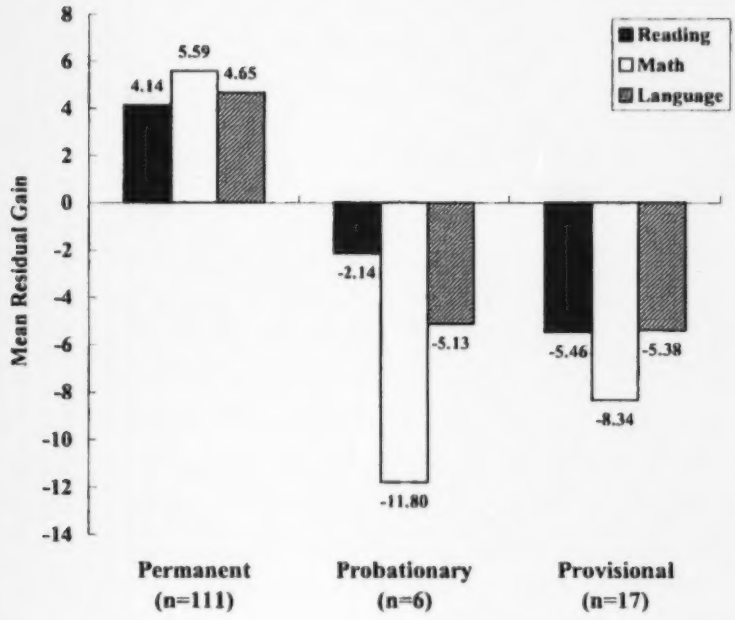

Figure 9 illustrates 2nd grade adjusted gains for EO students by teaching status. The results indicate that permanent teachers had students with significantly larger adjusted gains than those students who had teachers with probationary or provisional statuses. In fact, in mathematics, the EO students who had probationary teachers scored larger adjusted losses than those students who had provisional teachers. This means that 2nd grade EO students had larger adjusted gains when they had teachers who were in a permanent status then when they did not. Because the sample sizes are so small for the probationary and provisional teaching statuses, no conclusions will be offered at this time. Future research should be done to either replicate or refute these results.

Figure 10
2nd Grade Adjusted NCE Gains for
ELL Students by Teaching Status

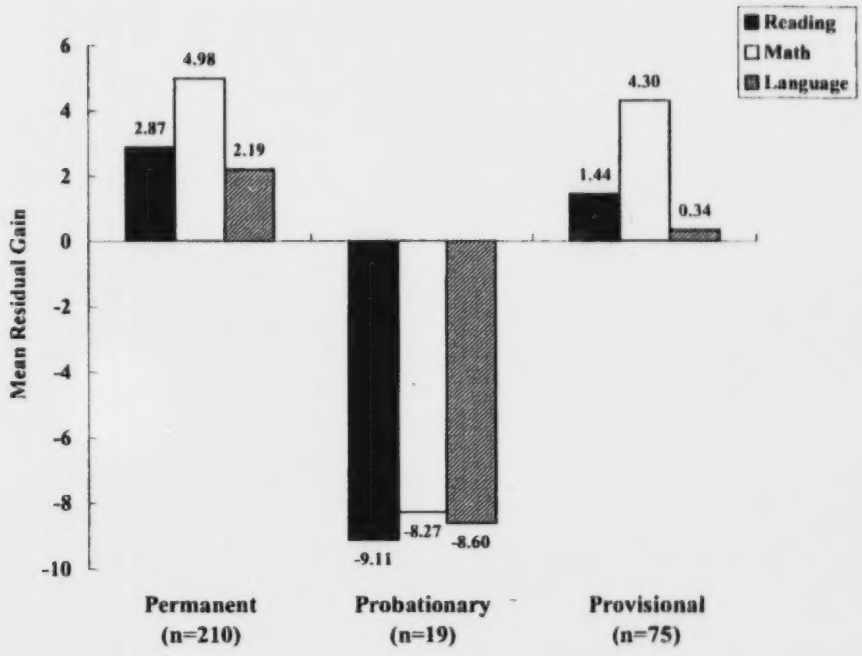

Figure 10 depicts adjusted gains for 2nd grade ELL students by teaching status. The findings revealed that students who had permanent teachers and provisional teachers scored significantly larger gains than those students who had probationary teachers.

The pattern of findings for 2nd grade ELL students was similar to the pattern found for EO students with regard to the adjusted gains for the students who had permanent and probationary teachers. However, the pattern for EO students was different from that found for ELL students who had provisional teachers. EO students had large adjusted losses, whereas ELL students had adjusted gains, on average. Additionally, ELL students who had provisional teachers had large adjusted gains in mathematics. The results presented in this figure are preliminary and need to be replicated in future research.

Figure 11
3rd Grade Adjusted NCE Gains for
EO Students by Teaching Status

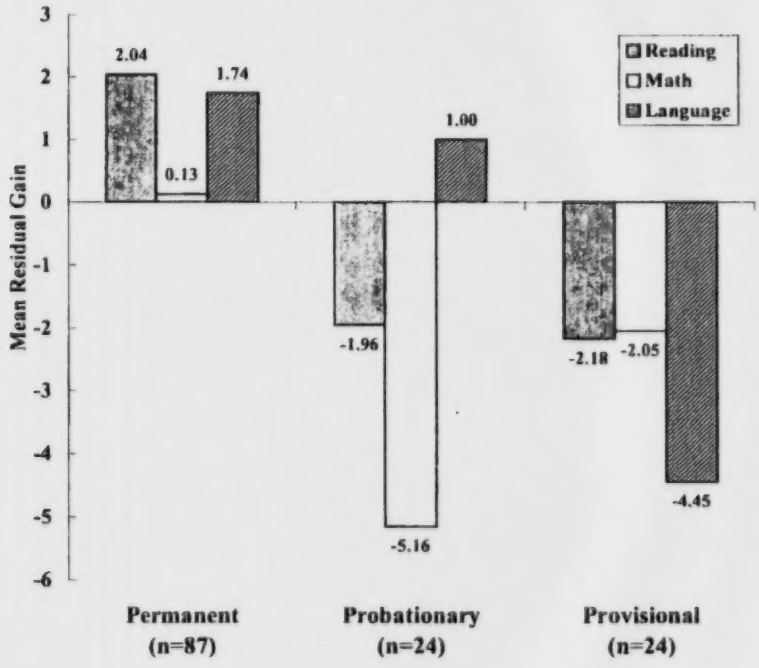

Figure 11 illustrates the adjusted gains for 3rd grade EO students by teaching status. The results indicate that those students who had permanent teachers scored positive adjusted gains. However, those students who had either probationary or provisional teachers scored negative adjusted gains (losses) on average. The findings presented in this figure are consistent with the results presented previously for 2nd grade EO students (Figure 9).

Figure 12
3rd Grade Adjusted NCE Gains for
ELL Students by Teaching Status

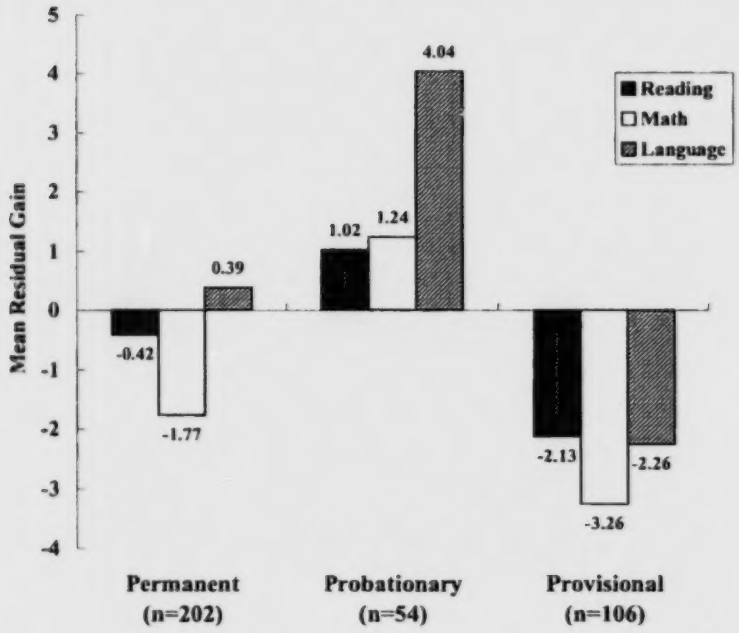

Figure 12 shows adjusted gains for 3rd grade ELL students. This figure indicates that students who had probationary teachers scored larger adjusted gains than those students who had permanent teachers and provisional teachers. In fact, the effect for language for the students who had probationary teachers as compared to those students who had provisional teachers was educationally important for mathematics (d=. 26) and language (d=. 43). This figure indicates that the effect of teaching status was significant for students who had probationary teachers in language and mathematics. The results depicted in Figure 12 for 3rd grade ELL students are very different than the results shown in Figure 10 for 2nd grade ELL students. In fact, the findings were in the opposite direction for 2nd grade students as compared to 3rd grade ELL students. The results found in this study need to be replicated in future research.

Summary of Findings from Figures 9-12

The results for 2nd and 3rd grade EO students are similar to each other with regard to teaching status. This means that on average, EO students who had permanent teachers had larger adjusted gains than those students who had either probationary or provisional teachers.

However, the findings for 2nd and 3rd grade ELL students were in the opposite direction from each other. This means that 2nd grade ELL students who had teachers that were either permanent or provisional had significantly larger adjusted gains then those students who had probationary teachers. Third grade ELL students who had teachers who were probationary scored significantly larger adjusted gains than those students who had teachers who were either in a permanent or a provisional status. The difference between 2nd and 3rd grade ELL students' patterns of scores may be due to the fact that teachers have been trained differently by grade; the test questions differed between grades in item difficulty; or there may have been more Spanish-speaking teachers in one group than in the others.

Conclusions and Recommendations

This study investigated the impact of teaching techniques and teacher characteristics in reduced size 2nd and 3rd grade classrooms using data from both classroom observations and matched student achievement scores. The analysis considered student characteristics and teacher characteristics. Both the 2nd and 3rd grade students had been in reduced size classes for three years. Thus, the average number of students per class meeting this criterion was less than 20.

While previous research suggests that smaller class size may help to improve student achievement, it is unclear how this outcome is related to the content of instruction in specific subject areas. Stasz and Stecher (2000) found that students in reduced size classes spent more time during language instruction writing narrative pieces. They also found that students engaged

in mathematics instruction played mathematics games, and examined relationships using numbers.

Stasz and Stecher (2000) examined other factors that may have affected their results. They compared teacher characteristics of those in reduced and non-reduced size mathematics classes. They found that there were a few significant differences in teacher attributes, such as having a master's degree and staff development that may result in increased student achievement. However, Stasz and Stecher (2000) were unable to examine the relationship between instructional practices and student outcomes because they could not link the data to individual students.

This study used multilevel modeling (HLM) to uncover the relationships between teaching strategies and characteristics, and student achievement. The results of the multilevel analysis revealed that after controlling for student-level variables such as language classification, grade level (2nd vs. 3rd), and spring 1999 SAT/9 NCE scores, the significant teacher-level predictors of SAT/9 spring 2000 NCE reading scores were teaching status (permanent vs. all others) and classroom management (see Appendix A). The findings further indicated that teaching status was a significant predictor of mathematics and language outcomes. Individualized instruction (see Appendix A) was also a significant predictor of language outcomes. This means that teachers who were credentialed and experienced had students who made the largest adjusted gains in reading, mathematics, and language. Additionally, those students who had teachers that provided clear directions, appeared enthusiastic, and maintained control of the classroom, had significantly larger adjusted reading gains than those students who had teachers who had not engaged in these aspects of classroom management. Students who had teachers that utilized individualization and engagement strategies had significantly larger gains than those students with teachers who did

not engage in the aforementioned strategies. Previous research supports the relationship between individualization techniques and smaller size classes (Molnar, Smith, Zahonk, Palmer, Halbach, & Ehrle, 1999).

The current study adds to the literature about the relationship between teaching techniques and behaviors and student achievement. The results presented in this paper have suggested that for 2nd and 3rd grade students in LAUSD, teacher experience and status (credential), as well as certain classroom techniques, improve student achievement.

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APPENDIX A

Teaching Strategies and Techniques

Individualization and Engagement

IT1: Began lesson w/ overview
IT2: Informed students what would be learned.
IT6: Used examples, illustrations/demos, to explain and clarify
IT7: Proceeded in small steps, but at a rapid pace
IT9: Asked questions that were directly relevant to new content/skill
IT10: Paused after asking question before calling on student
IT11: Made sure all students participated on a roughly equal basis
IT12: Acknowledged correct responses as such
IT13: When response partial or incorrect, tried to elicit correct response
IT16: Teacher monitored progress during seat work

Redundancy, Practice, Modeling

IT3: Informed students of how lesson related to previous lessons.
IT5: Checked for prior learning and retaught if necessary.
IT8: Included degree of redundancy in lesson.
IT14: Teacher modeled behavior/activity students were to perform.
IT15: Students were provided with opport. to practice what was learned.
IT17: Alternate activities were available when students finished.

Classroom Management

IT4: Teacher provided clear direction.
IT18: Teacher appeared enthusiastic/animated.
IT19: Teacher maintained control of students.
IT20: Teacher positioned self to see all in room.

APPENDIX B

Description of Teacher and Student Samples

There were 44 2nd grade (48%) and 47 3rd grade (52%) teachers in the analysis. The percentage of White teachers was 40.8%, followed by Hispanic (29.6%). The next largest group was Black (16.3%) followed by Asian (10.2%) teachers. The majority of teachers were fully credentialed, with only 7 of 44 2nd grade and 11 of 47 3rd grade teachers holding emergency credentials. Of the 91 teachers, 15 (15%) had a bilingual credential.

There were 810 (49.6%) female and 845 (51.4%) male students in the analysis. The majority of students in the sample were Hispanic/Latino (73.2%), followed by Black (10.5%), and White (8.5%). The proportion of students in the study was similar to the districtwide proportions with regard to ethnicity. Over 80% of the students participated in the free or reduced lunch program.

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